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ABSTRACT

The Zimbabwe Secondary School Science Project (ZIM-SCI) developed student study guides, corresponding teaching guides, and science kits for a low-cost science course which could be taught during the first 2 years of secondary school without the aid of qualified teachers and conventional laboratories. This ZIM-SCI study guide presents activities and experiments for a unit dealing with the human senses. Anatomy and physiology of the eyes (sight), ears (hearing), tongue (taste), nose (smell), and skin (feel/touch) are investigated. The study of these individual sense organs is then related to the structure and function of the nervous system. Parts of the brain as well as major nerves are examined during dissection of a rat. The unit concludes with simple experiments designed to establish concepts of reflex action, reflex arc, and voluntary and involuntary actions. Information is provided throughout the unit to help students understand the concepts behind the activities and experiments. (JN)

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ZIMBABWE SECONDARY SCHOOL SCIENCE PROJECT

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YEAR 2

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STUDY GUIDE . UNIT J

Sense from Senses

SE043982

UNIVERSITY OF ZIMBABWE
AND MINISTRY OF EDUCATION AND CULTURE

VOL. 2

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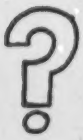
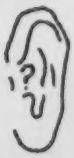
for "Experiment"
When you see this sign, read the instructions carefully from beginning to end before you start to do the experiment.



for "How much do you know?"
This is for you, to help you to test whether you are remembering what is important.

for "Written work"
This is when you must answer questions in writing.



for "Listen to the teacher and do exactly what the teacher tells you to do"

for "Activity"
This symbol will appear whenever you are asked to do something without your apparatus.

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SEPTEMBER 1983

ZIM-SCI

ZIMBABWE SECONDARY SCHOOL SCIENCE PROJECT

GENERAL SCIENCE

STUDENTS: Please read this carefully. It will help you.

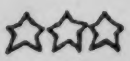
How you will study

This Study Guide comes to you with a kit of apparatus. Both things are part of a study programme leading you to an understanding of aspects of science. In this course you will be carrying out experiments. The Study Guide will help you to understand the scientific principles behind the experiments.

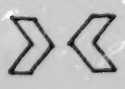
Your work should be done as you are instructed, either by the teacher or the Study Guide.

To help you to see quickly what you must do, the Study Guide uses these symbols:

for "Read and revise your notes and Study Guide"



for "Take note of an important point that you should learn"



for "Summary. This is to help you to go over what you have learned"

AIMS OF THIS UNIT

At the end of this unit you will be able to:-

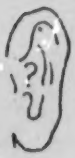
1. identify the different areas of taste on the tongue.
2. demonstrate that the sense of smell affects the sense of taste.
3. show if all areas on the skin are equally sensitive to stimuli.
4. state what light is.
5. distinguish between opaque and transparent objects.
6. distinguish between reflection and refraction.
7. distinguish between convex and concave lenses.
8. state how the bending power of the lens depends upon its thickness.
9. identify and describe the different parts of the eye.
10. describe the structure of the retina in terms of rods and cones and relate it to your ability to see colour.
11. explain how long-and short-sightedness occur and which lenses would correct these defects.
12. explain the source of sound.
13. state requirements for the transmission of sound.
14. state how the length of vibrating objects affects the fre frequency and the sound they produce.
15. how the tension (pull) in a vibrating object affects the frequency and the sound it gives.
16. explain how certain musical instruments can give different sounds.
17. list the different parts of the ear and the order in which they are arranged.
18. explain simply how the parts of the ear function.
19. state the purpose of the nerves.
20. distinguish between voluntary and reflex actions.
21. list examples of reflex action.
22. describe a simple reflex arc.
23. name the main areas of the brain.
24. state the main functions of each part of the brain.

UNIT J

SENSES UNIT

In Unit A you learnt about the various senses by which you are able to learn a lot about your environment.

DO YOU REMEMBER WHAT THESE ARE?



Yes! You have senses of sight, hearing, smell, taste and feeling.

What are the organs concerned with these senses?

Discuss this with your teacher.

You have also discovered that your senses are limited. However, they remain very useful to you! The whole body is dependent upon them to communicate with the outside world. It is the sense organs which receive information on what is going on in our surroundings. They are able to do so because they contain cells which are sensitive to this information e.g. cells in the skin are sensitive to pain, heat, cold; cells in the eyes are sensitive to light and cells in the ear are sensitive to sound. The sensitive cells which receive information are called RECEPTORS. This word comes from the word 'receive'. The information that is received by the receptors is called a STIMULUS.

What stimulus is involved when you see somebody?

Light! Light is the stimulus that stimulates the sensitive cells in the eye.

Information received by the receptors is passed on to the brain. The brain makes you aware of what is going on. How the information is passed on to the brain is going to be treated in some detail later in this unit. In this part of the unit we shall concentrate on the various sense organs and how they work.

THE SKIN

The first sense organ we shall consider in some detail is the skin.

Do you remember in what way the skin helps us as a sense organ?

That is correct. The skin gives us information about pain, heat, cold, touch.

You have a large area of skin by which all this information is detected or recorded.

Is the skin all over this large area equally sensitive?

To find out you will now do an experiment.

EXPERIMENT 1:

Are different parts of your body equally sensitive to touch?

You will need: two pins.

N.B. We know that it is fun to prick someone with a pin but remember this is a scientific experiment and you are the scientists! So do not prick hard since you may hurt your friend.

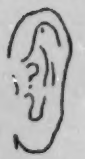
Diagram 1

Diagram 2

Copy down the heading and the table which your teacher has put on the board.

Hold the two pins as shown in diagram 1.
Ask your partner to close his/her eyes.
Touch lightly (as shown in diagram 2), with a pair of opened pins, different parts of the body: the palm, back of the hand, the fingers, the leg, toes etc.
In each test start with pins opened about 1 cm and ask how many spots are being touched - one, or two?
Bring the points of the pins a little closer together and ask again.

When you reach a stage where the reply is "one" although you are still using two points, measure the distance between the points. The distance that you measure gives the minimum distance between the receptors in that area of the skin.



Discuss your results with your teacher and the following questions:

What does a small distance tell you? Does it mean the skin is very sensitive?
Which part did you find to be the most sensitive?
Which part did you find to be the least sensitive?
Write up this experiment in your notebook with the conclusion you have arrived at.

How is it that some parts of our body are more sensitive than others?

Activity: 1

Observing sensitive cells in the skin.

You will need:

Bioviewer, Bioset and Strip ZS/4.

Look at slide 4 under your bioviewer and read the corresponding information on the bioset.

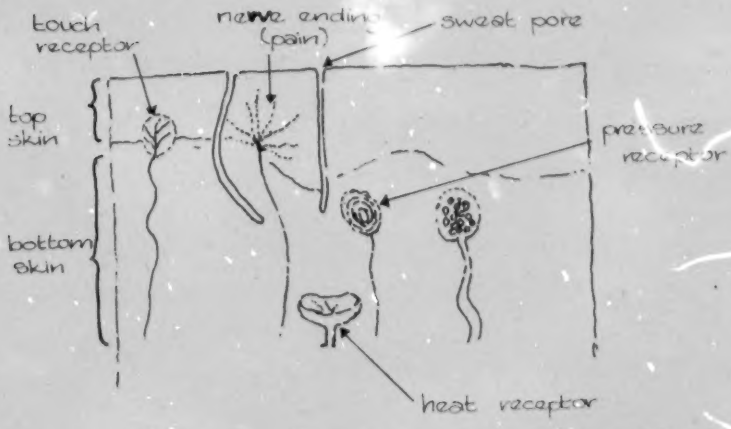
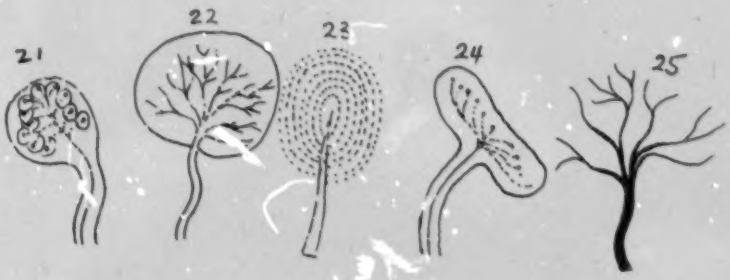


DIAGRAM SHOWING RECEPTORS IN THE SKIN

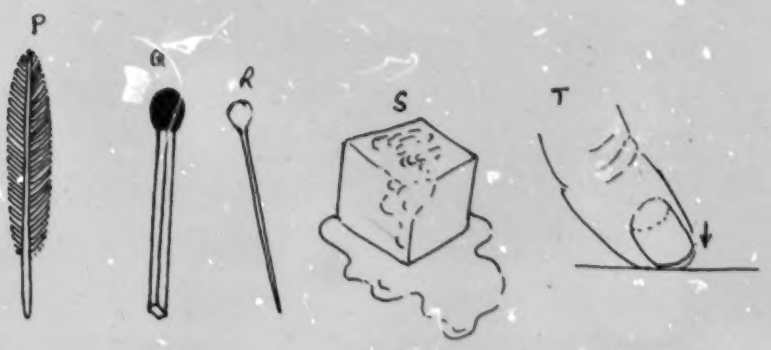
Now look carefully at the diagram of the skin above.
You can see different nerve endings (ends of sensitive cells) just below the surface of the skin.
How many different types of nerve endings are there altogether? Count them. There are five different nerve endings or receptors.
Different receptors receive different stimuli. Some parts of the body are more sensitive than others because they contain a greater number of receptors.
To help you think more about receptors and stimuli do the following exercise.

Exercise 1 Matching Stimuli and Receptors

Using information in the preceeding paragraph, match the numbered receptors with the lettered stimuli below:



RECEPTORS



STIMULI

P-feather Q-match R-pin S-ice T-thumb pressing

TASTE

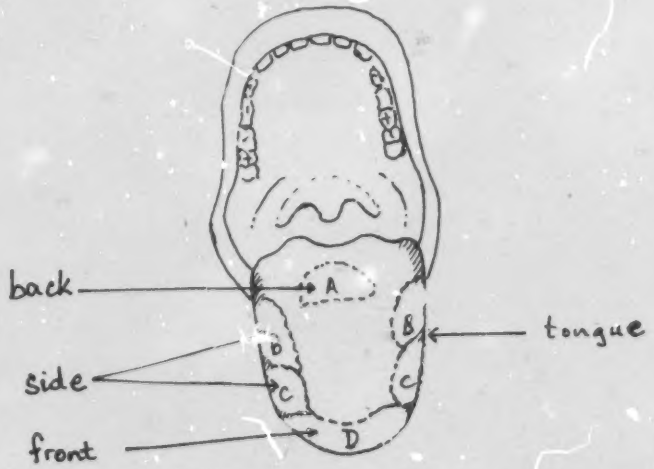
The second sense you are going to learn about is the sense of taste. You might already be thinking about your next meal! How many teaspoons of sugar do you put in one cup of tea? I put two. Three would be too sweet for me. I am sure you realise that the tongue is the organ which detects taste, but which part of the tongue tastes sweetness? Is it the front, back, sides or the whole tongue?
To find the answer to this question we need to carry out another experiment!

Experiment 2:

Finding out which area of the tongue detects the four tastes best.

You will need:

a clean drinking straw
sugar solution (sweet)
common salt (salt)
vinegar (acetic acid) (sour) or sour milk
pill solution (bitter)



Diagram

Copy the heading and the table which your teacher has put on the board.

Rinse your mouth with water. Ask your friend to dip a drinking straw into the sugar solution. Extend your tongue out as shown in the diagram. Your friend should now use the straw to place a drop of sugar solution, one at a time, on the back of the tongue, the side and then front, at positions shown in the diagram. Make sure the drop does not run to other areas. Rinse your mouth again.
Which area is best for tasting sweet things?
Record your answer in the table.
In the same way find out the areas good for tasting sour, salty and lastly bitter things. Remember to rinse your straw and mouth each time you change from one solution to the other. Lastly change over and let your friend test his taste!

Draw an outline of the tongue and mark where you detected each taste best.

Taste buds:

Activity 2: Observing taste buds

You will need:

handlens
bioviewer
biostrip and bioset Zs/4

Write down the heading 'Taste Buds'

Ask your friend to extend his/her tongue.
Observe this tongue through a hand lens. What do you see?

a. Now take bioset Zs/4 and look at slide 5 showing the vertical section of the tongue. Draw this diagram and label the pimples, pits, taste buds, muscles and salivary glands.

b. Carefully look at slide 6 which shows a vertical section of taste buds.

i. Draw a simple diagram of what you see. Label taste buds, pits and opening.

ii. Copy also the diagram of a taste bud shown. Label the small hairs, the nerve and sensitive cells.

iii. How do the following help in tasting: saliva, smell hairs, nerve?

SMELL

Have you had an occasion when you smelt nice cooking food and your mouth 'waters', or salivates? I have, and many people salivate at the smell of good food. What does this suggest to you? Is there any connection between our sense of taste and our sense of smell? You are going to carry out an experiment to answer this question.

EXPERIMENT 3:

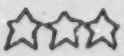
Does our sense of smell help our sense of taste?

You will need.

some potato chips
some clean water

1. Chew a piece of potato chip so that you 'know' how it tastes.
2. Rinse your mouth with water.
3. Pinch your nose between your finger and thumb so that you cannot smell.
4. With your nose pinched, chew another piece of chip
   Can you taste the chip as before?
   Does your nose help you to taste?

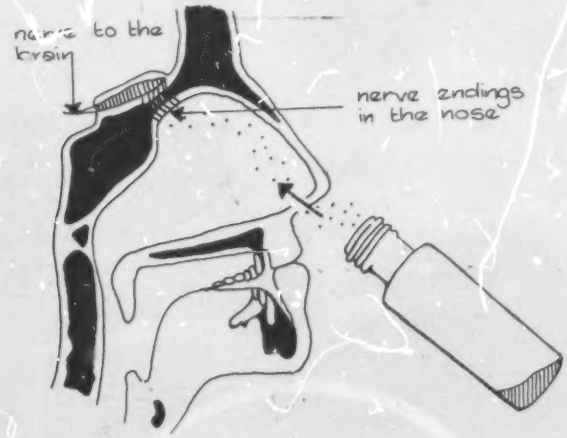
In the previous experiment you discovered that your sense of taste is affected by your sense of smell. Can you explain why, when you have a bad cold, your food does not taste so delicious?



When you have a bad cold your nostrils are blocked and you cannot smell. Subtle, interesting qualities of food are detected by smell 'RECEPTORS' (nerve endings) in the nose.

What you actually call taste in food is combination of taste and smell.

To understand how you smell, carefully study the diagram below.

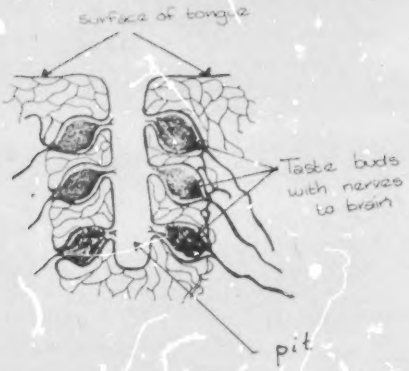


You can see from the diagram above that your organs of smell are in the air passages of the nose and consist of nerves which end in very fine hairs. Molecules in form of vapour from a substance come into contact with these hairs before you can smell the substance.

Now do exercise 2

Exercise 2 : Tasting

1. The sense of ___ is important in giving us the pleasure of food. It is also important for detecting any possible toxic poisonous food. Bitterness is a sign of potential poison.
2. By means of a diagram , show the areas of the tongue which detect salty, bitter, sweet and sour things.
3. Study the diagram below which shows part of the tongue .Suggest why you continue to taste certain substances after you have swallowed them.



4. Explain why it is difficult to taste food when you have a cold.

5. The skin is capable of distinguishing between a a light touch, such as a feather, and a heavy touch such as probbing(poking) the skin. Explain how the skin is structured to detect these differences.

6. Do you think it is important to be able to detect pain ? Give your reason.

THE EYE

You are next going to learn about your sense of sight.
How important is this sense to you? Close your eyes and imagine you were blind since birth.
How much information about your surroundings would you be missing? Quite a lot I am sure! Think about why you cannot see things in darkness.
What does this suggest to you? Good!
This suggests that your sense of sight depends upon light.

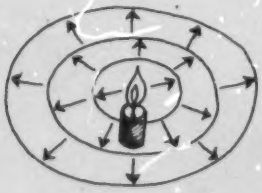
In order to understand how your eyes work you need to discover a few things about light itself.
Where do we get most of our light during the day?
That is correct. We get most of our light from the sun.

The sun itself consists of a very hot flame of gases.
Your teacher will light a candle to help you think about how light is sent to us.

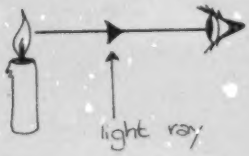
Since you can all see the light energy from the candle, it means light energy has been sent in different directions.
If you were above the flame you would still see the flame.

☆☆☆ Therefore light energy must travel in ALL directions: up, down, sideways, etc.

If we think only about horizontal directions, light energy travels out in a disc which gets bigger and bigger as shown in the diagram below.



It is convenient to represent light energy by lines as shown below. We shall call these lines RAYS of light energy.



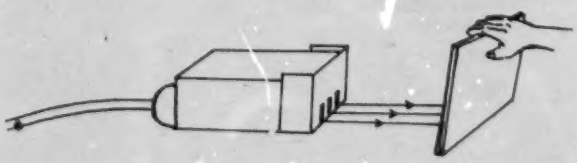
You will now carry out experiments to find out what happens to rays of light energy when they fall on various objects.

EXPERIMENT 4

Changing the direction of light energy

You will need:

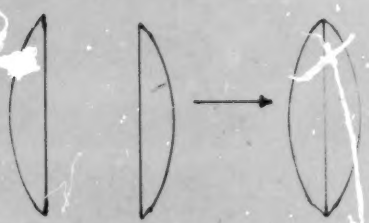
a mirror
a battery box loaded with 6 cells
a light source
triple slit screen
a biomount
white paper or your Study Guide.



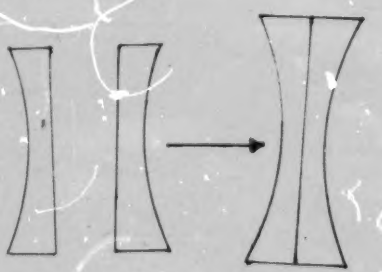
1. Connect your light source to the battery box and place a triple slit screen so that light can come through the slits as shown above.
2. Place the mirror as shown in the diagram. The apparatus must be placed on white paper so that you can see the light clearly.
   (a) What happens to light energy after it falls on the mirror?
   (b) Draw a sketch diagram showing light going to the mirror as shown above. Show also what happens to this light energy after it has fallen on the mirror.
3. (a) Remove the mirror and replace it with a biomount.
   (b) Draw a diagram to show the light energy before and after it falls on the mirror.

Discuss the results of this experiment with your teacher.

You have seen that opaque objects change the direction of light energy by reflecting it. In the next experiment you will investigate the bending of light by transparent objects called lenses. The diagrams below show the various types of lenses.



2 half convex lenses combine to form a full convex lens



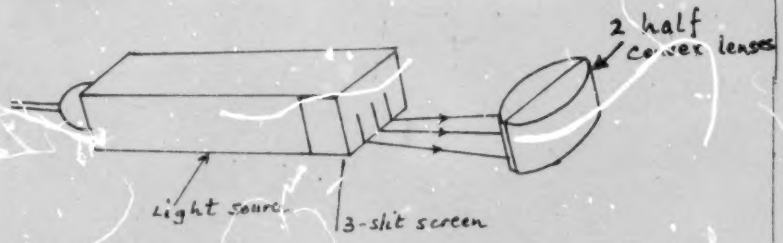
2 half concave lenses combine to form a concave lens

EXPERIMENT 5

Bending light using lenses

You will need:

2 half convex lenses (your teacher will show you)
1 concave lens (your teacher will show you)
a strip of khaki paper
a light source
a triple slit screen
a pair of tweezers/forceps



1. Do this experiment on a white surface so that you can see the light clearly.
2. Place your 2 half convex lenses as shown in the diagram above. diagram.
   (a) What happens to light energy after it hits the convex lenses.
   (b) Draw a diagram to show the light energy before and after it hits the lenses.
3. Remove the convex lens. Close one of the slits with a strip of khaki paper. Use saliva for sticking. You now should have light coming through the two slits only as shown in the diagram below.

4. Now place a concave lens (the smallest in the kit) in the way of light using tweezer/forceps.
   (a) What happens to light energy after it hits the concave lens?
   (b) Draw a diagram to show the light energy.

Let us now summarize what you have learnt in the previous experiments with your teacher:

1. Certain substances, e.g. glass, allow light to pass through them. These are called TRANSPARENT substances.
2. Certain substances, e.g. a plane mirror (painted glass) REFLECT light. They are OPAQUE substances. Light actually bounces from opaque substances like a tennis ball bounces from the ground. Scientists call this bouncing REFLECTION. Light is reflected from opaque substances. People do not allow light to pass through them either. They are opaque and they reflect light. We see most things by reflected light.
3. When light passes through transparent objects it can be bent. This bending is called REFRACTION. Light is refracted. Notice the difference between reflection and refraction.

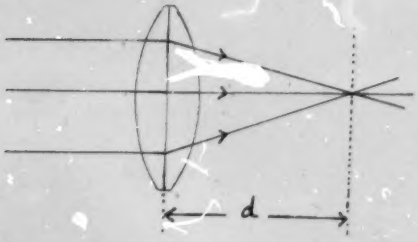
In refraction light passes through the object, but in reflection light does not pass through the object.

4. (a) When light rays pass through a convex lens, they are brought to a point. Light rays are said to CONVERGE to this point. So a convex lens is sometimes called a converging lens.

   (b) When light rays pass through a concave lens they are DIVERGED. So a concave lens is sometimes called a DIVERGING lens.

Now do Exercise 3 which your teacher has put on the board.

You have seen that when light energy passes through a convex lens it is refracted to one point as shown below.



The light rays meet at a distance 'd' from the centre of the lens. You will now carry out an experiment to find out what happens to distance 'd'

(a) If the thickness of a lens is changed

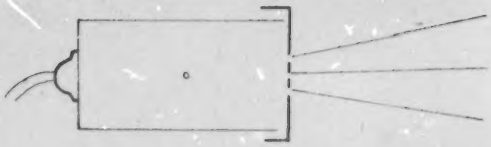
(b) If the source of light is moved nearer to or farther away from the lens.

EXPERIMENT 6:

Changing the distance 'd' between the centre of the lens and the meeting point of light rays by changing lens thickness.

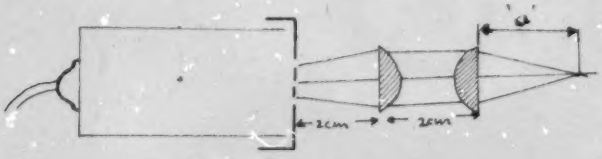
You will need:

a light source
3 half convex lenses
triple slit screen
ruler

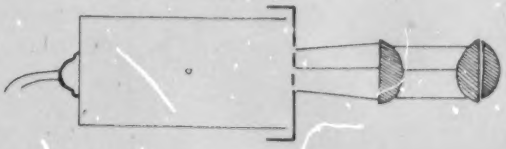


1. Arrange apparatus to produce light coming through the 3 slits as shown above.

2. Place a convex lens about 2cm away from the light source. This will make light coming through the 3 slits parallel.



3. Place another convex lens 2cm away from the first lens as shown in the diagram above. In this experiment you are interested in finding out how well the second lens converges light. Measure distance 'd'.



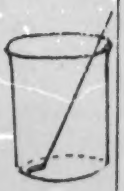
4. Now place another lens to the second lens as shown above. You now have a thicker lens by combining the two lenses. Measure the distance 'd'.
   a. Compare this distance with the previous one. Which is longer?
   b. What can you say is the relationship between the thickness of a lens and the distance 'd'?

You have learned from the previous experiment that the thicker lens converges light more than a thinner lens. In other words the distance between the lens and the point where light meets when it converges depends on the thickness of the lens.

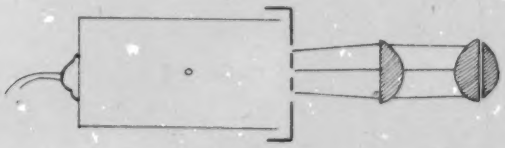
Another factor that affects the distance 'd' is the distance between the source of light and the converging lens. You will carry out an experiment to find out how this distance is changed.

EXPERIMENT 7. Changing distance 'd' by changing light source distance.

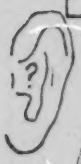
You will need:



light source
3 half convex lenses
triple slit screen
ruler.



1. Set up apparatus as shown in the diagram above. This is the same set up as you finally had in the previous experiment.
2. Move the light source backwards (i.e. farther away from the lenses).
   a. What happens to distance 'd'.
   b. What can you say is the relationship between the distance 'd' and the distance between the lens and the source of light.

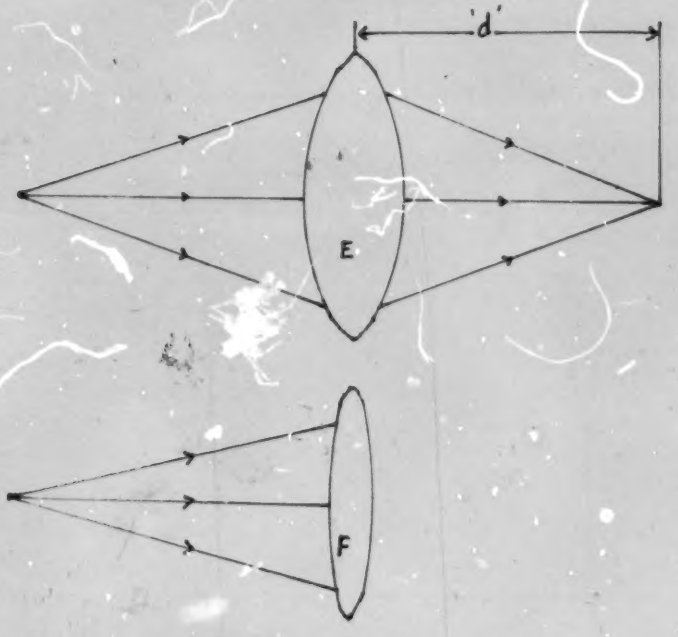


Discuss the results of the above experiment with your teacher

Now do Exercise 3

Exercise 3 : Lenses

The diagrams below show the same light source used with convex lenses of different thicknesses. The lenses are at the same distances from the light source.



a. Which lens is thicker?
b. Which lens is going to converge light nearer?
c. If at lens E the light source were to be moved nearer the lens, what would happen to point G (the meeting point of light energy).

In the previous section you gained some background knowledge on light. As you will see this knowledge is very useful if you are to understand how the eye works. You will now start the study of the eye by looking at its external structure.

THE EYE

Activity 3: Structure of the eye (external).

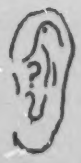
1. Work in pairs.
2. Look at the eyes of your friend. In the centre of the eyes you'll see small, round dark areas. Take note of their size.
3. Ask your friend to stand at the window and look at an object in bright light.
4. Look closely at the small dark areas of your friend's eyes. Again take note of their size.
5. Ask your friend to turn round and look into the classroom where the light is dull. Take note of the size of those small round dark areas of the eyes.
6. Make sure that both of you do the observations.

What do you notice about the size of the dark part of the eyes when your friend looks outside and when he/she looks in the classroom. Discuss this with your teacher.

The small dark areas in the centre of the eyes which you were observing in the above activity are called the pupils of the eye. This pupil is a circular opening which allows light to get into the eye. This opening is created by muscles called the iris which joins up to form a circle leaving an opening in the centre. Contraction and relaxation of the iris alters the size of the pupil depending on what you are looking at.

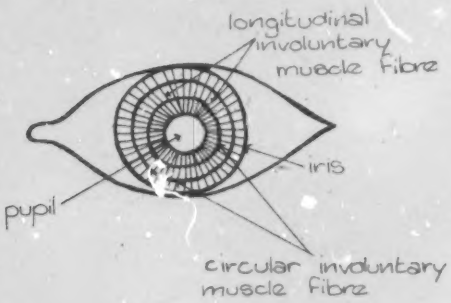
From your observations you correctly noticed that the pupils became small when your friend looked outside; and large when he/she looked inside. If you look into bright light the iris contracts thereby reducing the size of the pupil, so that less light enters the eyes. If this did not happen too much light would enter and damage the eye.

What happened to the size of the pupil?



The pupils became large when you looked into the classroom.
Why do you think this happened?
Discuss this with your teacher.

How is the size of the pupil altered? Look at the diagram below.



1. Contraction of the longitudinal muscles results in the dilation (enlargement) of the pupil in diffuse(weak or dull) light.

2. Contraction of the circular muscles results in constriction(narrowing) of the pupil in bright light.

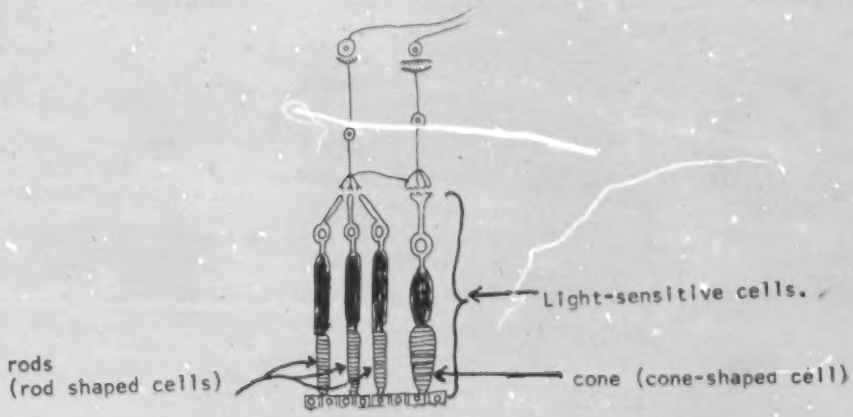
Activity 4: Inside (internal)structure of the eye.

1. Look at slide 7 of the Bioset ZS/4. This shows the sectional structure of the eye.
2. Draw what you see and label the following parts: cornea; iris; lens; retina; optic nerve; muscle. In between the cornea and the lens is a transparent solution known as aqueous humour. Label it. In between the lens and retina is a solution known as vitreous humour. Label it.
3. Read the bioset and answer the following questions:
   a. Which four structures, as seen under the bioviewer, are transparent?
   b. Since they are transparent what do you think is their function?
   c. What forms the retina? From this, work out the function of the retina.
   d. What is the function of the following:
      i. optic nerve.
      ii. iris.
      iii. muscle.

You already know from Unit B that light is a form of energy. You used the solar cell to convert light energy into electrical energy. In the eye a similar thing happens. The retina has light sensitive cells which convert light energy into some form of electrical energy. It is this electrical energy which flows out of the eye through the optic nerve. When this energy gets to the brain, the brain gives meaning to what you see.

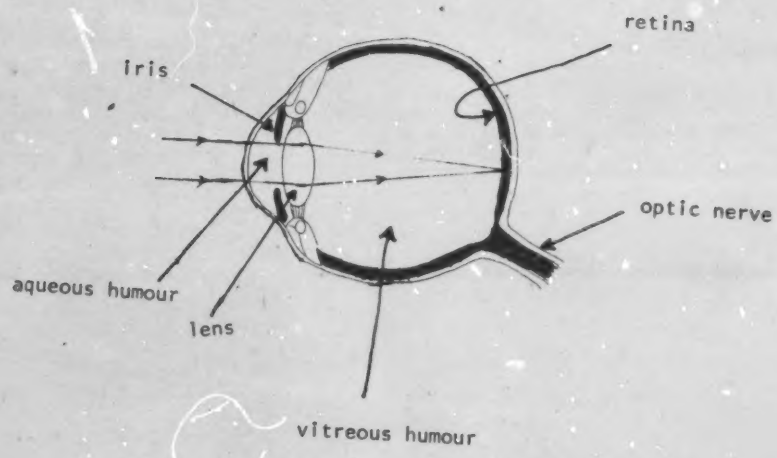
But what is it in the retina which makes the eye so sensitive to light?

In the retina there is a layer of cells sensitive to light. There are two kinds of these light-sensitive cells called, according to their shape, CONES and RODS.



The cones are sensitive to bright and coloured light. So when you see a blue, red or green shirt, you must know it is your cones which are at work! The rods work in dim light. You will learn a lot more about what causes this difference.

From the preceeding activities you have learnt how the eye works. A thing that produces light of its own is called a LUMINOUS object e.g. the sun or a lamp sends light straight into your eyes and you see it. A thing that does not produce light of its own is called a NON-LUMINOUS object e.g. a tree or a person, receives light from a luminous object and reflects this into your eyes. The light is refracted by the following TRANSPARENT eye structures: the cornea, aqueous humour, the lens and the vitreous humour. As shown in the diagram below light falls on the sensitive retina.



At the moment I will mention that the two types of cells work with the aid of two different chemicals. The chemical in the cones does not readily react even in bright light. On the other hand the chemical in the rods reacts readily even in dim light. So the rods are useful in dim light because they contain a chemical which can react in dim light.

You will now carry out an activity to investigate the distribution of cones and rods on the retina.

Activity 5: Investigating the distribution of rods and cones in the retina.

1. Select a partner, then sit on a chair looking at a point on the blackboard, or wall, straight in front of you.
2. Ask your partner to stand behind the chair. Cover your left eye and extend your arm out sideways. Ask him to place a piece of chalk of a colour unknown to you in your right hand. Move the chalk forward until it just enters your field of vision(you can just start seeing it)
3. Stop as soon as the chalk is visible.
   Keep looking directly ahead.
4. Identify the colour of the chalk.
5. Move the chalk further forward.
6. Identify the colour again.

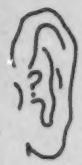
What does this activity illustrate about the distribution of the rods and cones?
You might have seen that when the chalk first enters the visual field (when you first saw it), its colour is not clear. At least you do not see the real colour of the object. Nearer the centre of the visual field, if it is green chalk, it appears green. This shows that there are more cones concentrated in a spot directly opposite the pupil than in the periphery of the retina.(i.e. as you move away from this spot.) Remember cones are the ones responsible for detecting colour. This is the area of most acute vision.
It is called the FOVEA or yellow spot.

Activity 6: Finding out if there is an area of the retina without rods and cones.

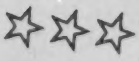
You will need:

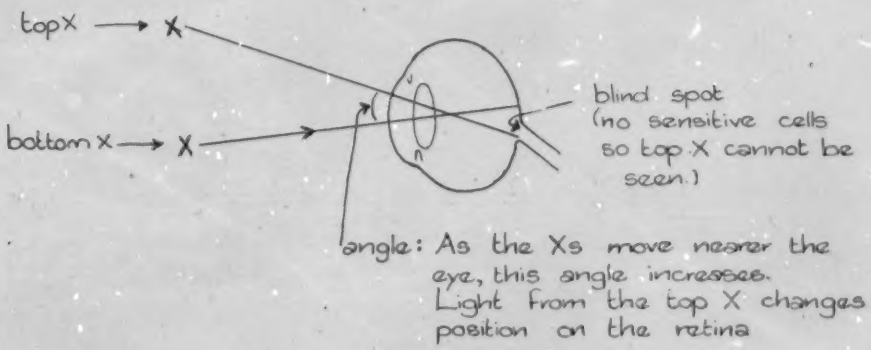
cardboard paper from your eye kit with two 'X's.

1. Hold the cardboard paper upright, about 45cm from your eyes.
2. Close the left eye and concentrate on the left X with the right eye. The left X must be directly in front of your right eye.
3. Slowly bring the cardboard paper closer and closer to the face.



What happens to the right X during this time?
Suggest an explanation and discuss with your teacher.
You have seen that when the cardboard paper was at a certain distance from the eye, the right cross disappeared. As you moved it much closer, both crosses could be seen again.
There must be an area on the retina which is not sensitive to light. This is called the BLIND SPOT and is the point at which the optic nerve joins the retina.



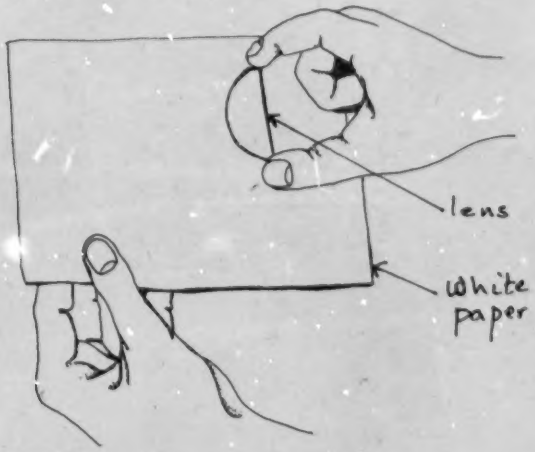


The position at which the light falls on the retina depends on the angle at which light enters the eye. As you move the cardboard paper there comes a point when all the light from one of the X's falls on the blind spot. If you move the card nearer, the light will fall on the other side of the blind spot, and then you can see again.

ACTIVITY 7 Making pictures with lenses.

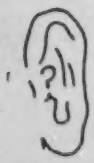
You will need :

the largest diameter convex lens from your eye kit.



Hold the lens between your finger as shown in the diagram and stand next to the wall opposite where windows bring most light in from outside the classroom.

Move the lens backwards and forwards until you see a clear picture on the wall. Scientists call a picture formed by lenses an IMAGE.



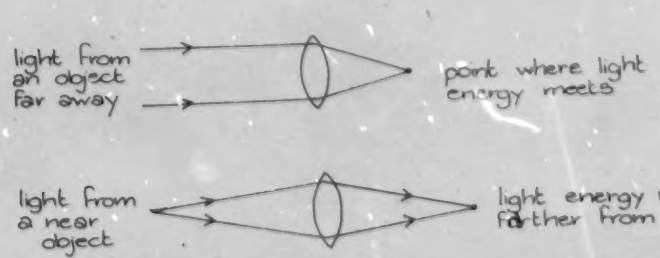
What do you notice about the image?

Discuss your observations with your teacher.

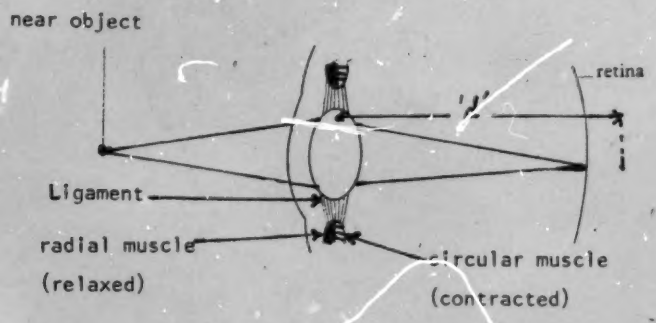
Your eyes work rather like the lens in this activity.

Do you remember carrying out an experiment in which you discovered that the distance from the lens to the meeting point of the light energy changes when the distance between the object and the lens changes?

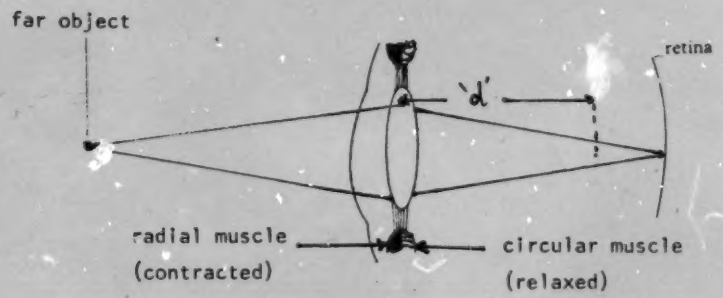
Here is a diagram to remind you of this experiment.


light from an object far away
point where light energy meets
light from a near object
light energy meets farther from the lens

You may also remember the power to bend the light depends on the thickness of the lens.
In your eye the distance between the lens and the retina cannot be changed. Instead the eye has an elastic lens and a ring of muscles which can alter its shape and bending power.



When the light from a near object meets slightly beyond the retina the contraction of the circular muscles cause the lens to become thicker and shortens distance 'd' so that light meets on the retina. (See diagram above.)



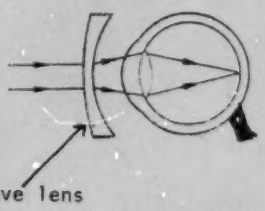
When the light from a far object meets before the retina, the contraction of the radial muscles causes the lens to be thinner and lengthens distance 'd' so that light meets on the retina. (See diagram above.)

The ability of the eye to change the thickness of the lens thus bringing light energy which is slightly away from the retina onto the retina is called ACCOMMODATION.

However, with old age the eye muscles become weaker. The lens loses its ability to stretch (loses its eleastic property) The person no longer can see objects clearly. To him they appear without sharp edges. Scientists say the objects appear BLURRED.

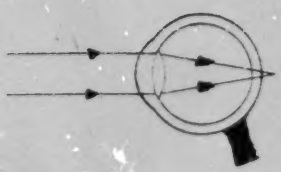
When this happens the ability of the eye to bring about ACCOMMODATION has to be assisted by eye glasses (spectacles). These glasses are in fact extra LENSES! Some people require spectacles even when they are young becasue they have developed bad eye sight at that age.
Look and study carefully the diagrams below showing eye defects and their correction.

SHORT SIGHT
Light converging before the retina, eye lens too powerful.

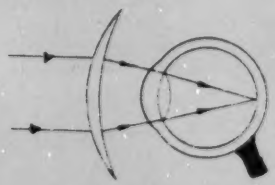


concave lens

SHORT SIGHT CORRECTED
Now light converges onto the retina the outside lens combines with the eye lens to make a system which is less powerful.



LONG SIGHT
The eye lens is not powerful enough.



convex lens

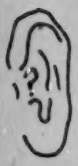
LONG SIGHT CORRECTED
Now light converges onto the retina, the outside lens combines with the eye lens to make a system which is more powerful.

To understand clearly how the eye looks you will make a model of the eye.

MODEL OF THE EYE

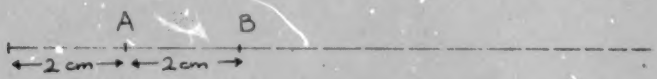
You will need:

a khaki strip of paper
a light source
a 3-slit screen
battery box with 6 new batteries
eye kit.



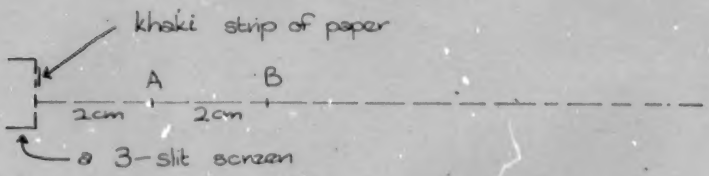
Since you have several lenses in your eye kit it is important to know when to use which lens. Your teacher will help you.

1. Draw a line on a white sheet of paper as shown below.

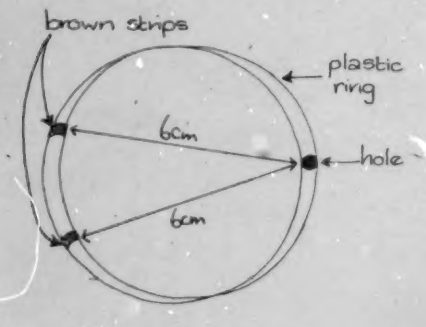


2. Mark 2 points A and B, 2cm and 4cm respectively from the left as shown above.

3. Close one of the extreme slits with a khaki strip of paper. Use saliva to stick the paper.
   a. Place the metal in such a way, that the line is in between the uncovered slits.

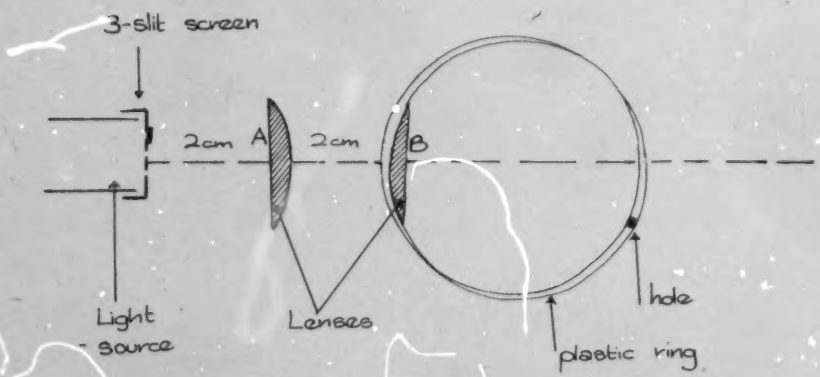


b. Stick the two brown strips at positions approximately 6cm from the hole. This serves as the iris. (See diagram below).



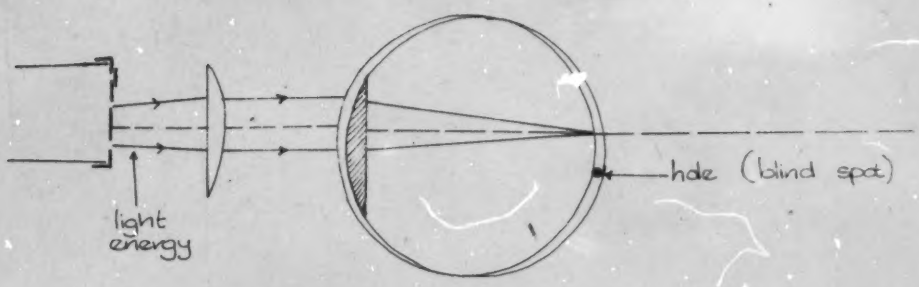
(This model represents a slice through an eye.)

4. Place everything else as shown in the diagram below.

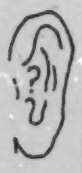


5. a. The light source represents the object you see.
   b. The lens outside the eye serves to produce parallel light.
   c. The plastic ring serves as the eyeball, the front part of which is the cornea and the back part of which is the retina. The hole represents the BLIND SPOT.
6. Now connect the light source to the battery.

You should then get something like this:



7. You may have to move the outside lens backwards and forwards in order to get the light to meet exactly at the retina.
8. Disconnect the light source immediately after you have seen what happens.



Discuss the differences between your model and the actual eye with your teacher.

9. a. Connect the light source again and then move it slightly clockwise. You should see the light on the retina moving towards the blind spot (the hole in the plastic ring).
   b. If you continue moving it you can get your light on the blind spot. You remember it is here that you cannot see things since there are no rods and cones there.
   c. Continue moving it until it passes the blind spot and goes into the sensitive area again. You can start seeing again. Disconnect the light source.

Now do Exercise 4 which your teacher has put on the board.

TWO EYES ARE BETTER THAN ONE

You might have wondered why people have two eyes.
Do you think there is any advantage in having two eyes?
To help you answer this question you will carry out some activities.

Activity 8 : Two eyes are better than one.

You will need:

2 sharpened pencils

Close one eye with one hand as shown in the diagram above.
With your other eye watch a friend move a pencil around.
The pencil should be held pointing upwards and your friend should stop moving it at some point in front of your face, as shown in the picture.
Now, still with only one eye open, hold another pencil horizontally in your hand and try to bring it in from the side in a straight line to touch your friend's pencil, point to point.

Now repeat this experiment with both eyes open.
Which is easier to use: both eyes or one eye?

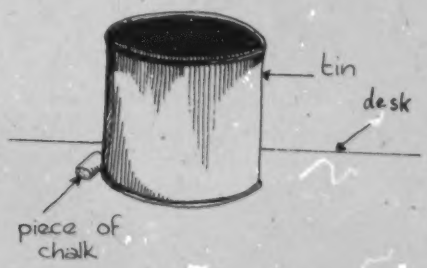
From this activity you might have discovered that two eyes are better than one in judging distance and in finding the exact position of an object.
You will now carry out another activity to find out how else two eyes are better than one.

Activity 9: Two eyes are better than one.

You will need:

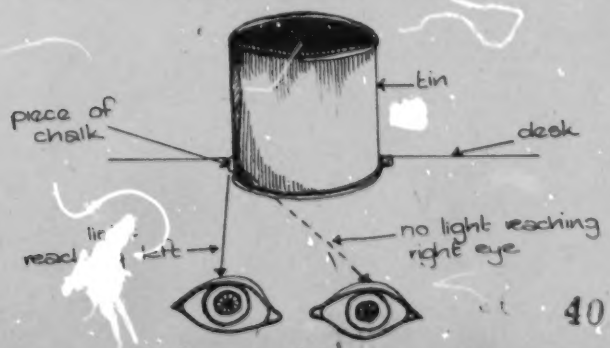
boiling tin
a small object (the size of a pencil rubber) e.g. a piece of chalk, a stone.

1. Work in pairs.
2. Place the boiling tin on your desk.
3. Sit on a chair about a metre away from the tin.
4. Look at the tin and make sure the tin is positioned in between your eyes.



5. Ask your friend to move the small object around and against the tin until you can just see it (i.e. until it is just about to disappear). He should leave the object at this point.
6. Close your left eye. Can you still see the object? Now open your left eye and close the right. Can you see the object?
7. Do the same activity with the object on the other side of the tin.
8. Repeat the activity with your friend observing while you move the object.

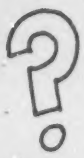
What does the activity tell you about two eyes as compared with one? Look at the diagram below.



If the person above has a left eye that does not work, he cannot see the object on the left but can see the object on the right using his right eye. If his right eye is not working he cannot see the right object but can see the left object using his left eye. In short it requires both eyes to see both objects at the same time. With two eyes, therefore, you can see a wider view of the object you are looking at.

CARE OF THE EYES

Your eyes are precious. Here are a few ideas to help you look after your eyes. Working or reading in poor light causes strain of the eye muscles, leading to headaches. Any defect will also cause eye strain and headaches. Your eyes should be tested when you suffer from persistent headaches to see whether spectacles are necessary. This should be done by a doctor. Do not attempt to put on your friend's spectacles as they may not be your type and size of spectacles. Wrong spectacles will ruin your eyes.



How much do you know?

1. a. Light is a form of ——— . It is convenient to regard it as travelling in straight rays.
   b. When light bounces back on hitting an object that is not transparent it is said to be ———
   c. An object is only seen by the eyes when light hits the object's surface and it is then ——— into the eyes (or it is giving off light itself).
   d. When light hits a transparent object, it passes through but bends on doing so. The bending of the light is called the ——— of light.
2. a. Lenses bend light in a particular way. A ——— lens converges (brings closer together) light and a concave lens diverges (spreads) light.

b. The eye consists of a system of lenses.

c. The eye can detect both the amount and the ____ of light.

d. In a normal eye the lens forms images on the ____

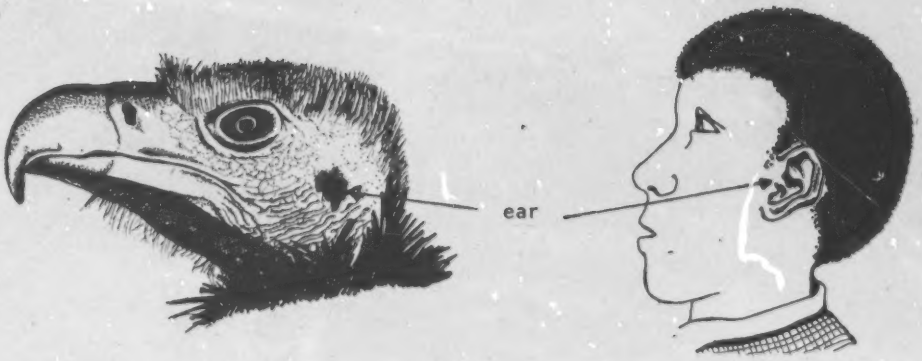
e. The lens changes its light converging power by changing its ____

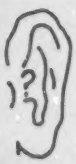
f. Long-sight and ____ are due to light not being converged on the retina.

g. A lens is used to correct long-sight and a ____ lens is used to correct short-sight.

Also do Exercise 5 which your teacher has put on the board.

One of the sense organs that most animals have is the ear. As you can see below, different animals have different sizes and shapes of ears.





How important are our ears to us?

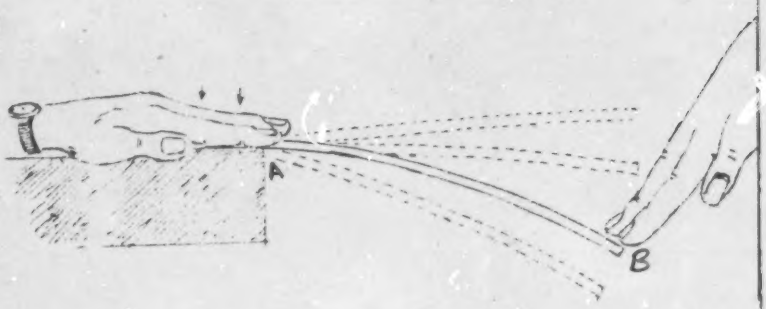
Discuss this with your teacher.

I am sure you enjoyed your discussion and came up with a number of useful ideas about how your ears are important to you. Basically we use our ears for hearing sounds.

In order to understand how our ears work we have to study a few things about SOUND.

EXPERIMENT 8 : How is Sound Produced?

We will use the experiment you did in Unit A_1 to develop more ideas on sound.
You will need:
your boiling tin
your ruler
an elastic band.



1. Stretch the elastic band around the tin as shown. Pluck the elastic. It will make a nice "twanging"sound! As the elastic makes the sound notice the up and down movement it makes.
2. Place the ruler on your desk and pluck it as shown in the second diagram above. As the ruler makes the sound notice the up and down movement it makes.

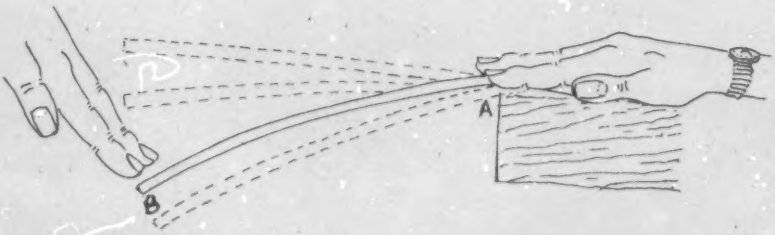
You have seen in the previous experiment that as both the elastic and the ruler are producing sound, they are moving up and down. This kind of repeated movement is called VIBRATION. We say the elastic and ruler are VIBRATING. They have Kinetic energy. What happens to this Kinetic energy? It is converted to SOUND. Sound itself is a form of energy which is produced when things vibrate.

Experiment 9:

What happens to the frequency when the length of an object changes?

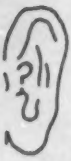
You will need:
a ruler

FREQUENCY AND LENGTH



(1) Put your plastic ruler on your desk as shown in the diagram. Pluck it. Notice the up and down movement of the ruler. Can you guess how many up and down movements the ruler is making in one second? The ruler probably makes 20-30 movements in one second. The number of up and down movements in one second is called FREQUENCY of movement.

(2) Pluck the ruler again to make it move up and down. Shift the ruler so that length AB becomes shorter. Pluck the ruler to set it moving. Observe the movement again. Does the ruler move faster or slower than with the previous length?



What can you say about the connection between length and frequency? Discuss this with your teacher.

FREQUENCY AND SOUND

(3) Repeat the experiment but this time concentrate on sound. Compare the sound produced when the ruler is short and when it is long.

a) When do you hear "higher" sound (sound similar to that produced by a mosquito) and when do you hear lower sound (similar to that produced by a big drum)?

b) What therefore is the connection between frequency and type of sound?

FREQUENCY AND TENSION

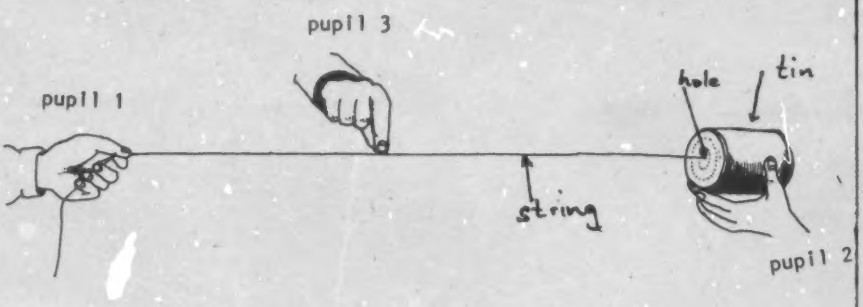
EXPERIMENT 10: What happens to the frequency of a string when the tension (pull) on it increases?

You will need:

at least 2m of string

a tin. with a hole made in the bottom. (This can be done using a nail and a stone.)

Work in groups of 3.



(a) Push the string through the hole in the tin. Tie a knot so that the string does not come out.

(b) Hold the string as shown above. The string must just be straight and not be too tight.

(c) The third pupil must pluck the string and all the three of you should observe the movement of the string up and down.

(d) Now pull the string tight. Pluck it as before and notice the movement. Compare this movement with the previous one.

(e) What can you say about the way the tension affects the frequecy of the string?

SOUND AND TENSION

Repeat the above experiment, but this time concentrate on the sound.

Compare the sound produced when the string is pulled very tightly and when it is not so tight.

a) When do you produce a "higher" sound and when do you produce a "lower" sound?

b) What therefore is the connection between sound and tension?

From the experiment answer the following questions:

(a) What happens to frequency when the tension increases?

(b) What happens to sound when the tension increases?

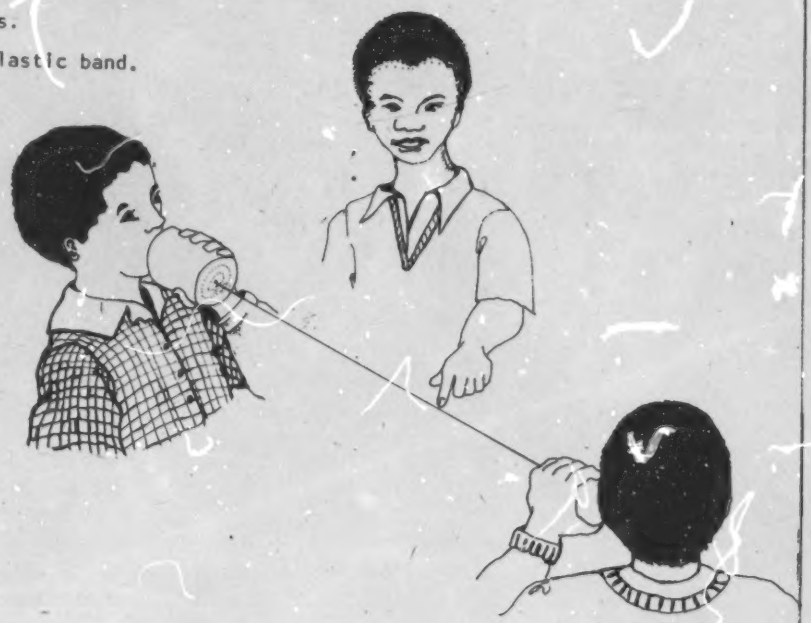
EXPERIMENT 11: Can sound travel through a solid?

You will need:

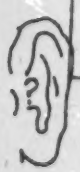
10m string

2 tins.

an elastic band.



1. Work in groups of three.
2. Pull the string very tightly as shown above.
3. One of you should now be listening through the tin while the other one is speaking into the tin at the other end. (See diagram above.) The one listening should be able to hear the one speaking clearly.
4. The two can now exchange so that the one who was listening is talking and the one who was talking is now listening.
5. At one point while the experiment is going on, the third pupil should lightly touch the string between the forefingers and thumb. What do you feel?
6. Keep changing positions to give everyone a chance to talk, listen and touch.

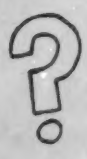


What can you learn from this experiment?

Can sound travel through a solid? Discuss this with your teacher.

Now, instead of using a string, use an elastic band.

Pluck the band and notice the vibrations.
Your friend should then stretch the band more.
Pluck the band and notice if there appears to be any change in the frequency of vibrations.
Listen to the sound the band makes and compare it with the sound made when the band was stretched less.

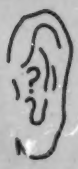


How much do you know?

(1) Sound is produced by _____ things. Unless a thing is vibrating it cannot produce sound.
(2) The _____ is the number of vibrations in one second.
(3) Frequency is increased by making the length of the vibrating object _____ .
(4) Frequency is increased by _____ the tension (pull) in the object.
(5) Sound travels through solids as well as air.
(6) _____ frequency is associated with high sounds and low frequency is associated with low sounds.

SOUND INSTRUMENTS

The ideas established above are useful in making sound instruments. Look at the picture of a drum (ngoma/ingungu) being used in African dances.

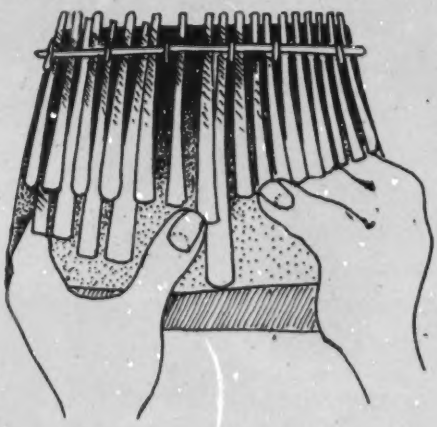


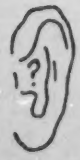
You might know what people do to a drum if they want it to produce a high sound! The drum is dried either in the sun or near a fire to get rid of moisture from the skin.

The skin then becomes quite tight. What then happens to the frequency? Good. Because of high tension in the skin the frequency is high and therefore the high sound is made. For low sounds the drum is less dry.

A guitar is another musical instrument which depends upon the tension in the wires. If you once made some form of a guitar you should be aware that the strings are pulled to different extents to get different sounds.

Another sound instrument in African tradition in some parts of Zimbabwe is 'mbira'. Look at the diagram of the 'mbira' below.





Can you tell how different sounds are made Tell your teacher.

You might have heard or seen 'marimba' musical instruments. Look at the diagram of the 'marimba' instruments below.

How do 'marimba' instruments work? To answer this question you will carry out an experiment.

Experiment 12: What happens to the sound when the air columns become shorter?

You will need: plastic bottle and water.

1. Blow over the plastic bottle so that you can make a sound.
2. Fill the plastic bottle up to a quarter with water and blow again to make a sound. Compare this sound and the previous one. Which is higher?
3. Repeat the experiment with bottle ½ full and then three-quarters full. Make a conclusion to this experiment and tell your teacher.

Make a conclusion to this experiment and tell your teacher.

You have discovered from your previous experiment that as the air column becomes shorter the sound becomes high. This is the way in which 'marimba' musical instruments are constructed. The vessels contain different lengths of air columns. The different columns produce different sounds. It is the air in these instruments which is vibrating. This applies to all wind-generated noises!

YOUR VOICE

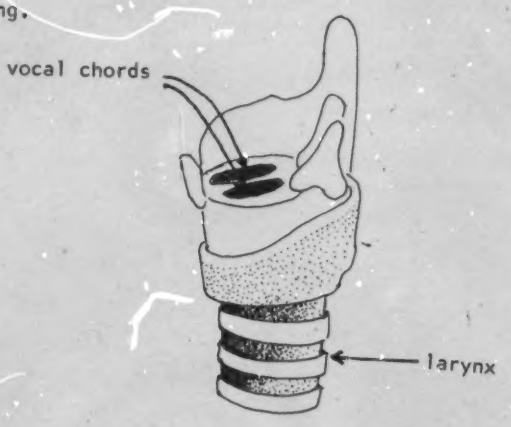
How do you produce sound?

Activity 10: Finding out the source of your voice.

Touch your throat as shown above.
With your fingers in position you should now hum.
What can you feel?

You should have felt vibrations within your throat. The part of your throat that is sticking out is sometimes called Adam's apple properly known as LARYNX.

Inside are two flaps or folds of skin (called vocal chords) which you can make to vibrate by exhaling air over them. The chords are controlled by muscles which alter the tension in the chords. The distance is also altered. This is how different sounds are obtained when you speak or sing.



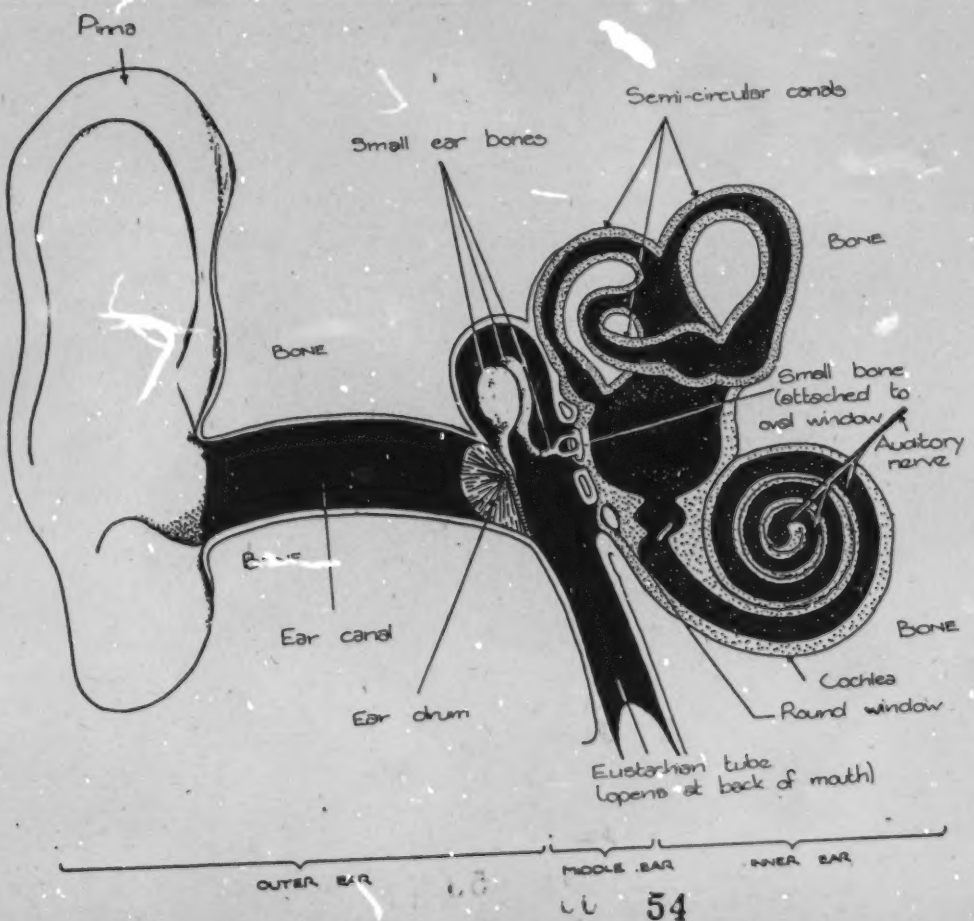
How much do you know?

1. Sound is caused by the vibration of solids, liquids and .....
2. Low sound is produced by ..... vibrations and higher sound is produced by ..... vibrations.
3. Frequency is the number of ..... per second.
4. A high sound is produced by a ..... vibrating column of air.
5. A low sound is produced by a ..... vibrating column of air.
6. Sound will not travel through a vacuum.

THE EAR

You now have some knowledge about sound to help you understand how your ear works. Now look at your friend's ear. What does it look like? Describe it. It looks rather like a funnel with a hole in the middle. What is a funnel used for?

I am sure you remembered that a funnel is useful when you are pouring water or any other liquid in a narrow-mouthed vessel. When you use a funnel you do not lose much liquid. In the same way the funnel shaped part of the ear is useful in collecting sound energy and directing it into the hole, that you see. This is all that is done by this outside structure of the ear and the structures that are responsible for hearing are inside your head. To have an idea of the structures study the diagram of the ear below.



PARTS OF THE EAR AND THEIR FUNCTIONS

Pinna - collects sound energy.

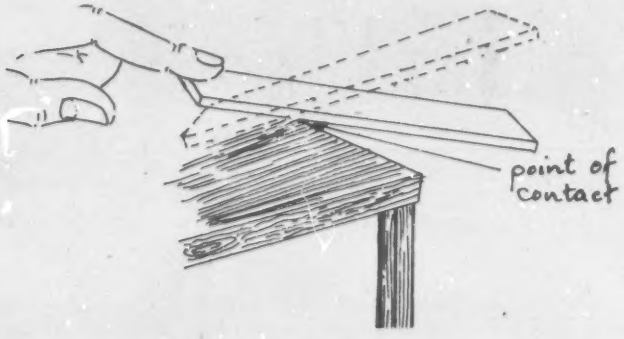
Ear Canal - This is a simple passage for sound energy to enter the middle ear.

Ear Drum - Part of the ear that is first set into movement by sound energy. It passes on sound energy to the three small bones in the middle ear.

Middle Ear - The three small bones receive sound energy from the ear drum and make the movement big.

You will do a simple activity to show how the small bones magnify the movement of sound energy.

Activity 11: Illustrating magnification of sound by the small bones in the ear.

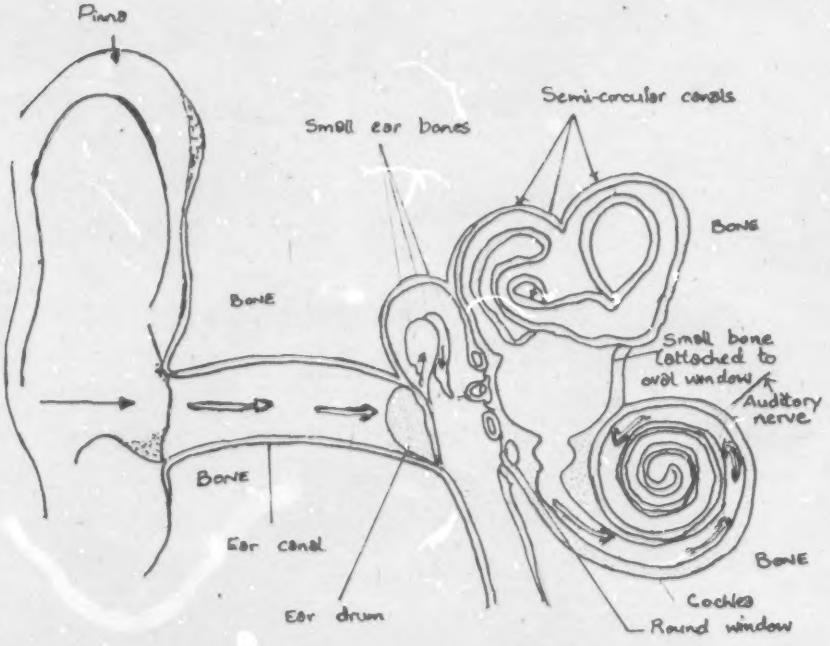


Place a 30 cm ruler so that the finger is 2cm from the point of contact. Now move the ruler down with your finger. Notice that a small movement of your finger results in a big movement of the other end of the ruler.

In the same way, the small bones in the middle ear serve to magnify the movement.

The inner ear looks like a snail shell. It contains nerves. Different nerves pick up different sounds.

With the aid of the diagram below let us follow along the path of sound energy.



(1) The sound energy is received by the external ear.

(2) The sound energy causes the ear drum to move.

(3) The vibration of the ear drum is passed on to the small bones.

(4) The small bones pass on the energy to the cochlea (inner ear).

(5) Nerves in the cochlea pick up the energy and send it to the brain.

(6) The sound is interpreted in the brain.

SENSE OF BALANCE

One of the important functions of the ear is to act as a sense of balance. Before you go into how the ear does this, you will do two activities to find out more about this sense.

Activity 12: Find out if the senses of balance and sight are related.

You will need: a handkerchief.

You should stand on one leg as shown above. Is it easy? Your friend should now blind-fold you using the handkerchief Find out which is easier, to balance with your eyes open, or blind-folded.

From the activity, what can you learn about the relationship between your sense of sight and your sense of balance.

Activity 1 3 : Sense of balance and your head

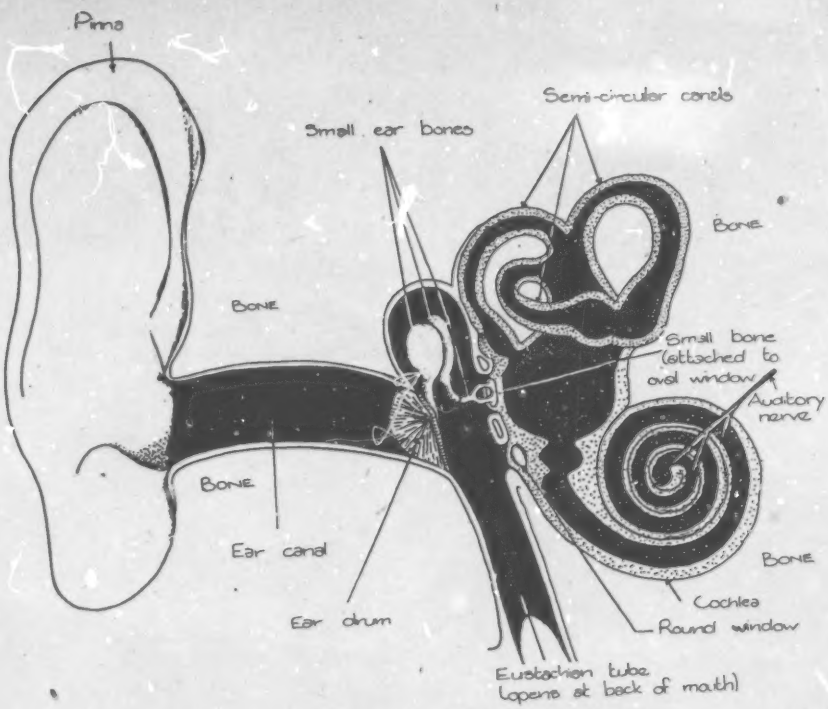
Stand up and rotate your head several times as shown above.

What can you feel? Is it easy to balance? What can you say is the relationship between your head and your sense of balance?

In the first activity you discovered that your sense of sight helps you to keep your balance. In the second activity you discovered that when you rotate your head you become dizzy and you lose your balance.

What does this suggest to you? Is your balance controlled in the head?

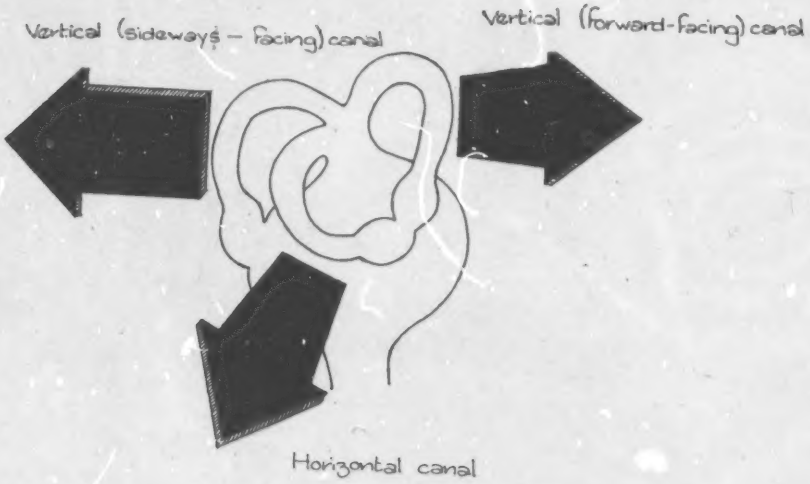
I have already mentioned that the ear has a balancing function. In the ear there are structures called the semi-circular canals. Look at the position and arrangement of the semi-circular canals on the next page.

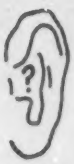


Inside the semi-circular canal there is a fluid which moves when we move or turn our head. The movement of the fluid stimulates the nerve endings in the canals, and the nerve endings in turn send the message along the nerves to the brain. Once again the brain interprets the message as movement and makes the body act to balance itself.

As you can see below, the three semi-circular canals are in planes at right angles to each other.

The fact that three different planes ensures movement of the head in any plane can be detected. In this case, if you shake your head the horizontal canal is stimulated; if you nod your head the vertical (forward facing) canal is stimulated, and if you move your head from one shoulder to another, the vertical (side-wards facing) canal is stimulated.



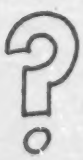


Your teacher will now show you a model of the semi-circular canals.

CARE OF EARS

Ears are very important organs and you must take care of them. The ear-drum is particularly delicate and you should not clean your ears with a stick or any other hard thing. You might damage it and will certainly fail to hear. The best thing to do when you have an ear problem is to go to your nearest clinic. The nurses at the clinic know a lot more about the ears and they will help you to clean it.

How Much Do You Know?



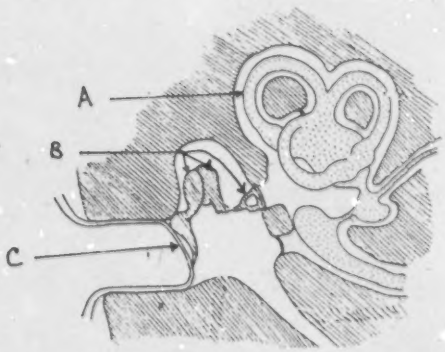
1. The ear is sensitive to _____ vibrations.
2. The ear consists of three major regions namely _____, _____ and _____.
3. The sound vibrations get into the ear through the _____.
4. The sound vibrations first make the ear-drum vibrate and in turn the vibration of the ear-drum causes the _____ in the middle ear to vibrate.
5. The last of the small bones is attached to the inner ear

at the structure called the ..... window.

6. The coiled structure in the middle ear is called the ..... and contains a fluid.
7. The sound vibrations cause the fluid to vibrate, this vibration is picked up by the nerve endings in the cochlea. The message of vibration is ultimately sent to the brain through the ..... nerve.
8. (a) The three semi-circular canals are a part of the ear responsible for.....
   (b) The movement of the head causes the movement of ..... in the canals; this movement is picked up by the ..... in the canals and sent to the brain.

Also do Exercise 6

Exercise 6: The Ear



The diagram above shows part of the ear.

(a) Give the names of the parts A, B and C.
(b) What is the function of each part?
(c) Why should you not use a stick to remove wax from your ears?
(d) One advantage of having two ears is that they help to detect the direction of sound.
What might be the other advantage?

THE NERVOUS SYSTEM

You already know that your sense organs e.g. eyes, skin, ears, pick up information in your environment. This information does not have meaning until it has reached you! "You" are inside your head in the brain. We cannot look at a human brain but your teacher has prepared a rat's brain for you to observe.

The importance of the brain in giving meaning to stimulation of the sense organs has already been mentioned. The sense organs, the spinal cord and the brain belong to a very important system in our bodies which makes us aware of our environment. It is called the NERVOUS SYSTEM. It is indeed a system of NERVES consisting of NERVE CELLS (NEURONS).

To get to know the various structures of the nervous system you will carry out a number of activities in which you will need:

bioviewer
bioset and strip ZS/4
a sharp pencil
a rubber.

Activity 14 : Central Nervous System

1. Read through the first page of the bioset ZS/4 and make notes to answer the following questions:

   a) What are the two main parts of the central nervous system?

   b) What are the two main functions of the central nervous system?

Activity 15 : Spinal Cord

1. Look at slide 1 of bioset ZS/4 showing the spinal cord.

   a) Draw a diagram of the spinal cord as you see it under the bioviewer.
   Label the white matter and the grey matter.

   b) What forms

      i. the grey matter and
      ii. the white matter?

2. Read more of the bioset and add notes as answers to the following:

   a) What are the two functions of the spinal cord?
   b) What is a reflex action?

3. Look at slide 2 showing the nerve cells (neurons) in the spinal cord. Compare what you see in the slide with the diagram shown on the second page of your bioset.

a) Copy this diagram and label the nucleus, nerve fibre, endoplates in muscle and nerve cells in grey matter and label the five branches sticking out 'dendrites!

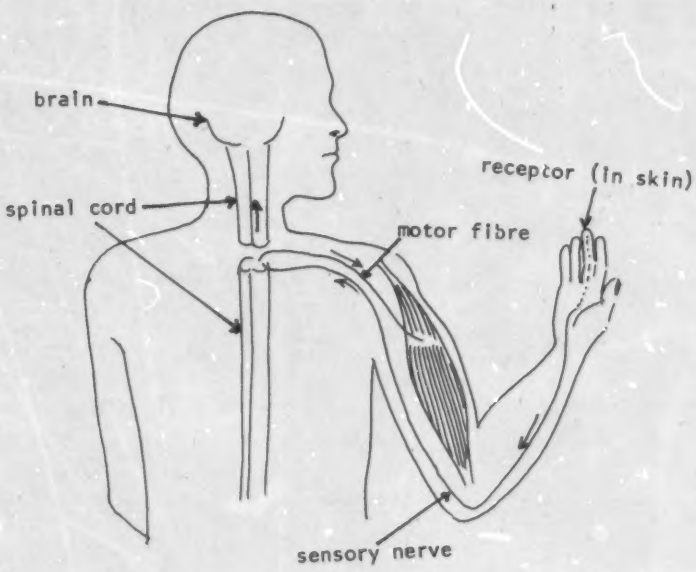
b) From your bioset write down the functions of these many fine branches sticking out!

4. Look at slide 3 showing nerve endings in a muscle.

a) Draw a diagram of what you see in the bioviewer - Label the muscle, nerve fibres and the flat plate.

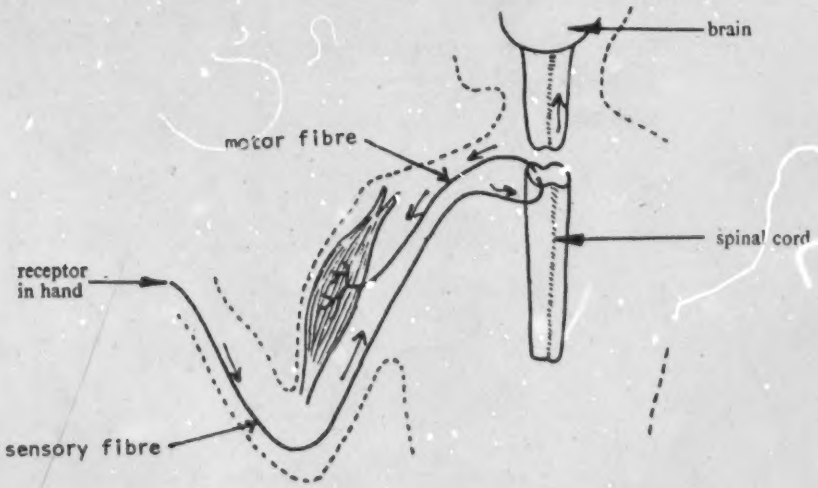
b) From the reading on the bioset, briefly outline how the central nervous system, the plate, the muscle and the sensory organs can be connected in bringing about body movement.

Lets look at a particular example:



Where does the message originate?
Correct, from the receptors (sensory organs).
In this case the receptors are in the skin. The message is carried to the Central Nervous System by the SENSORY fibre. From the Central Nervous System to the muscle, the message is carried by the MOTOR fibre. The message in the motor fibre has 'instructions' from the Central Nervous System that the muscle must contract so that it can move the arm.

Sometimes action is taken before the message reaches the brain, i.e. before you are conscious of what is happening. For instance, if you accidentally touch a hot object, you remove your hand automatically and after a short while you then become aware that you were burning your fingers!



Look at the diagram above. Follow the path of the message. You will notice that when the message reaches the spinal cord, it immediately sends a message of 'instruction' to the muscle to contract and remove the finger from the hot object. At the same time the spinal cord sends another message to the brain which brings awareness of the situation. This RAPID, AUTOMATIC RESPONSE to the stimulus is called a REFLEX ACTION.

☆☆☆

A reflex action happens when the message from the sensory organ receptors is a very strong one. It helps us avoid serious injury by causing action more quickly than if we have to think about it!

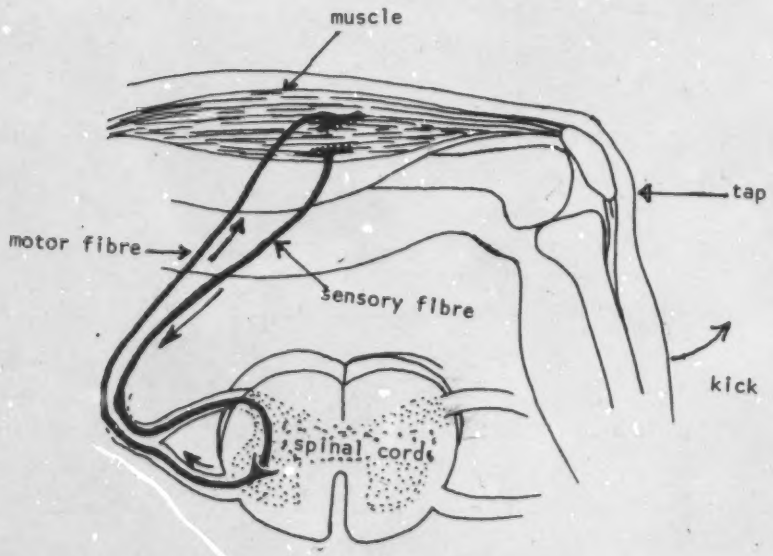
The path followed by the message (from the receptor to the spinal cord and straight to the muscle) is called a REFLEX ARC.

☆☆☆

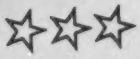
Here are some activities which demonstrate reflex actions.

Activity16: KNEE JERK

You should work in pairs. Ask your friend to sit down with his/her legs crossed lightly and vertically at the knee. You should tap his/her upper knee lightly at the base of the knee-cap.
What do you see? A light kick of the leg occurs.
Notice that your friend is not making an effort to kick.
It just happens as you tap. Your friend, though aware of the action, cannot control it.
Why do you think a reflex action happens here?



What takes place in our body during a reflex action of knee jerking?



1. The tapping below the knee-cap strongly affects the nerve endings in the thigh muscles.
2. The message is sent by the nerve endings along the sensory nerve to the spinal cord.
3. When the message is received by the spinal cord, it (the spinal cord) sends out a 'reply' along the motor nerve to the thigh muscles.
4. The automatic contraction of the muscles causes the lower leg to give a kick.

Activity 17: SWALLOWING

Lightly hold your throat between the thumb and forefinger. Swallow saliva. What do you feel? Movement up and down. Once the movement has started, try to stop it. Can you stop it?

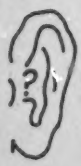
Activity 18: BLINKING

Ask your friend to stand in front of you with his/her eyes open. Now clap your hands 5 cm away from his/her nose and at the same time watch his/her eyes.
Does he blink?
Ask him to try and control his eyes as you clap your hands again. Can he manage?

Let us now put our ideas together about reflex actions.

1. Since they are automatic, it is difficult to control them once they are started.

2. The brain is only required to make the animal aware or conscious of e.g. the pain. The consciousness does not influence the response; actually, the sensation of pain appears about the same time or even after the response has taken place.



Now try to think about more examples of reflex actions and tell your teacher.

INVOLUNTARY AND VOLUNTARY ACTIONS

You already realise that reflex actions occur without our conscious control. There are other actions in the body which are not reflex actions but go on without our conscious control. Can you think of some? Good.
I am sure your examples include heart beat, and breathing. Most of the time we are not even aware we are breathing or that out hearts are beating. Both these actions and reflex actions are sometimes known as INVOLUNTARY ACTIONS.
These are quite different from VOLUNTARY ACTIONS.
VOLUNTARY ACTIONS take place with our full awareness and we consciously control how they happen. Think of examples. Here are some: Lifting up this book; chewing food and kicking a football.

REACTION TIME

Except in an emergency where reflex action happens, you have learned that your senses, e.g. the eyes, when stimulated, send a message to the Central Nervous System which gives meaning and orders appropriate action to happen. The time taken from stimulation to reaction is called REACTION TIME.

MEASURING REACTION TIME:

Activity 19 : Reaction time

Since your reaction time is too short to be measured on a clock I have worked out a scale that you can use. This scale has been worked out by knowing the connection between time and distance for an object that is falling. Here is a table showing the time the object would take to fall certain distances.

Reaction Time	Distance
0,05 s	12 mm
0,10 s	44 mm
0,15 s	110 mm
0,20 s	196 mm
0,25 s	306 mm

Do all people have the same reaction times?
Do you think your reaction time is the same when you are feeling sleepy?

You will need: a ruler

1. Hold the ruler vertically so that the bottom 'zero' graduation on the ruler is level with your friend's fingers as shown in the diagram.
2. You drop it. As soon as your friend sees the ruler starting to go down, he should catch it with his fingers.
3. Read the length from the bottom of the ruler to where your friend's fingers hold.

4. Use the table above to find out your friend's reaction time by finding out how long the ruler took to fall that far.

5.. Your friend should now help you find your reaction time.

6. Who is quicker at reacting?

You now know your reaction time under the conditions of the experiment. But is reaction time of any importance to you? Think about yourself riding a bicycle and suddenly a dog crosses your path. What do you do?
You brake your bicycle before you hit the dog. If your reaction time is long, you may hit the dog and probably hurt yourself as well. If you were driving a car you would have a serious accident. Reaction time is affected by many things. For example: Drivers should not drink alcohol when they are driving. A person with alcohol in their system takes longer to react. This means that when he sees an object in front of him, he will take longer to apply his brakes than if he were sober, and the chances of him getting involved in an accident are greatly increased.

Besides affecting our brains and causing us to say foolish things, beer and all other alcohol, if excessively taken, slows down our brain and our reflex actions. It can impair our sense of balance, (because our reaction time to changes in balance is slower) causing us to walk unsteadily. Again we lose our ability to think clearly and often take needless risks, causing accidents to ourselves and others. Tobacco and dagga have similar effects, to varying degrees.

How much do you know?

1. The _____ system is the 'telephone system' of the body. It provides communication lines throughout the body system.

2. The functional unit of the nervous system is the _____ cell, or neuron; the brain, spinal cord and nerves consists of millions of neurons.

3. Nerves take _____ to the brain. When the brain receives this information it interprets it, and sends messages along other nerves causing a response in the muscles.

4. The brain is divided into distinct structural and functional regions. The broad divisions are: cerebrum, _____ and medulla oblongata.

Also do Exercise 7 which your teacher has put on the board.

SUMMARY

1. Different areas on the tongue detect different tastes.
2. The sense of taste is affected by the sense of smell.
3. Certain skin areas are more sensitive than others.
4. Light is a form of energy.
5. Opaque objects do not allow light to pass through them. They reflect some of it.
6. Transparent objects allow light to pass through them. They can bend this light. This bending is called refraction.
7. Convex lenses are thicker in the middle and thinner at the ends. They converge light to a point.
8. Concave lenses are thinner in the middle and thicker at the ends. They diverge light.
9. Light is refracted onto the retina as it passes through the cornea, the aqueous humour, the lens and the vitreous humour.
10. The retina consists of cones and rods which are sensitive to light. These convert light energy into electrical energy and send it to the brain for identification through the optic nerve.
11. Thicker lenses refract light more than thinner lenses.
12. Sound originates from vibrating objects.
13. Frequency is the number of vibrations per second.
14. Frequency increases as the length of the vibrating object increases. The tension (pull) in a vibrating object also increases the frequency.
15. A high frequency gives a high sound.
16. Matter is required for the transmission of sound. Sound cannot travel through a vacuum.
17. The ear consists of 3 major regions namely: the outer ear, the middle ear and the inner ear.
18. The nervous system consists of nerves, the spinal cord and the brain.
19. It is the function of the nervous system to relay messages through the body.
20. A reflex action is a rapid automatic response to a stimulus. It is not a conscious action.
21. The brain together with the various sense organs make you aware of what goes on in your environment.